

**Ignition Tube Instructions:**

1. Hold the cylinder horizontally and fire one squirt of the fuel from the atomizer bottle into the center of the cylinder.
2. Slowly swing the cylinder from above your head to your knees. Do this twice. This is to mix the fuel with sufficient air to form an explosive mixture (carburetion).
3. Fit the sponge plug into the top of the cylinder so that about 10mm protrudes
4. Insert the lighter into the small hole at the base of the cylinder, aim the cylinder away from the students and operate the lighter.
5. There should be a pop and the foam plug (the piston) should be ejected.
6. If the cylinder does not fire it you do not have enough air in the mix. Try to waft the cylinder one more time with the foam stopper still inserted and then try again.
7. If the cylinder still does not fire, remove the plug and waft the cylinder around until you have cleared the Cyclohexane from it. Repeat from 1. above.

**Only use Cyclohexane as other fuels can cause damage to the cylinder.**

Please see a demonstration video of the experiment on our Youtube channel 'Irwin Science Education'.



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# Ignition Kit Instructions





#### Fire Syringe Contents

- 1 x Irwin Fire Piston
- 1 x cotton wool
- 2 x rubber washers

#### Diesel Engine Operation

A diesel engine differs from a petrol engine in that there is no spark produced to ignite the fuel/air mixture. In a diesel engine the heat produced to ignite the mixture is produced by the rapid compression of the gases in the cylinder. The Fire Piston simulates this process by igniting a small sample of cotton wool when the piston is rapidly pushed downwards.

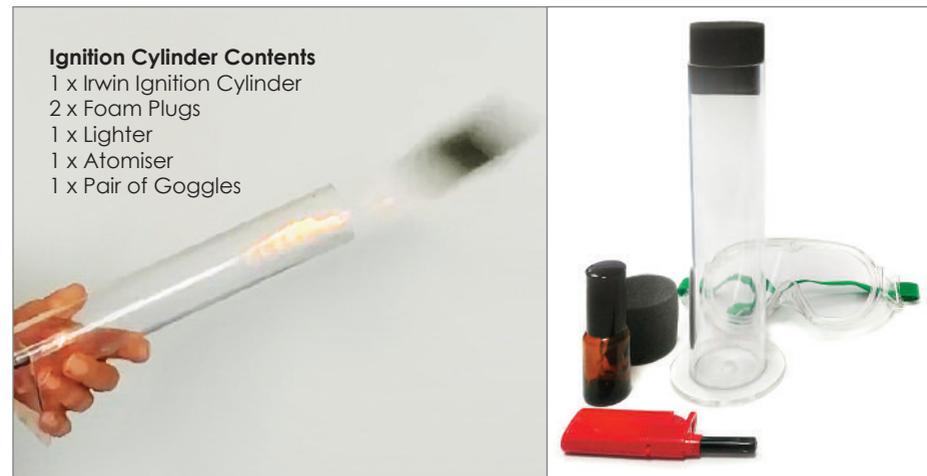
#### The Fire Piston

The Fire Piston comprises an acrylic tube sealed at one end with a close fitting rod which is used to compress the air. The rod has a circular cap bonded to it which may be pushed rapidly downwards using the heel of the hand.

#### Instructions:

1. Set the tube vertically on a firm surface
2. Unscrew the top section and pull out the piston. Tease open a small pinch of cotton wool and push it down to the bottom of the tube using a stirring rod or similar.
3. Carefully insert the rod into the tube and screw the top onto the tube. You should feel an increase in pressure as the rod is pushed down the tube.
4. Firmly grip the base of the cylinder and rapidly push the rod to the bottom of the tube using the heel of your hand.
5. The movement of the rod (the piston) rapidly increases the temperature of the trapped air (see gas laws for a further explanation) and the temperature rises to the flash point of cotton. The cotton wool bursts into flames.

**Please note.** If the fire piston is operated empty you will notice a mist forming on the upstroke. This is because the air is cooling as the pressure decreases. Adiabatic cooling occurs and small dust particles in the trapped air act as condensation nuclei. Water vapour in the air condenses on these nuclei and a cloud is formed. The formation of clouds may be discussed. In meteorology, as the air rises it expands because as altitude increases, atmospheric pressure decreases. Kinetic energy is converted into potential energy and the air temperature decreases, causing the relative humidity to increase. This causes condensation on dust particles and hence a cloud is formed.



#### Ignition Cylinder Contents

- 1 x Irwin Ignition Cylinder
- 2 x Foam Plugs
- 1 x Lighter
- 1 x Atomiser
- 1 x Pair of Goggles

#### The Ignition Cylinder

The ignition cylinder is designed to demonstrate how internal combustion in car (petrol) engines provides energy to drive the car. The Irwin Fire Piston demonstrates how a diesel engine works in comparison. The combustion cylinder is of acrylic construction and is open at the top with a small hole in the bottom.

The open end accepts the foam bung (piston), the lower end or ignition point is where the spark simulation (lighter) is inserted. The demonstration is normally prefaced with a discussion about how the internal combustion engine works describing mixing petrol with air to form a mixture through carburetion and the cycle of the engine through induction, compression, ignition and exhaust. The ignition cylinder simulates the carburetion and ignition strokes.

**Safety Notes:** The carburetion simulation requires the use of a flammable liquid, Cyclohexane, to be vaporised by a small atomiser which is available from Irwin.

**Do not use any other atomiser, fuel or higher volumes of fluid than detailed.**

This demonstration must only be performed by an experienced and qualified teacher and adequate care and responsibility must be maintained about the handling and use of flammable chemicals.

**Please note:** Sometimes, if the mixture is incorrect, the explosion will not be sufficient to blow out the foam plug but may blow back through the ignition hole. We highly recommend using a glove to protect your hand under these circumstances. We also supply a pair of goggles which it is recommended are worn when performing the experiment.

**Note:** The lighter is supplied with gas and will produce a flame. This is not strictly necessary as the spark will ignite the mixture. Once the gas has been exhausted the lighter will still ignite the mixture. Should you wish to demonstrate with a spark only, simply depress the gas filling port with a pencil to vent the gas.